

Archaeology

Electroplating origins in Peru

The technique of electrochemical plating of precious metals, long thought to have been an invention of late medieval or Renaissance Europe, has been found to have an independent, and perhaps earlier, origin in South America.

In an article in a recent issue of *American Antiquity*, Dr Heather Lechtman, of the Massachusetts Institute of Technology, and two colleagues report on the analysis of gold-plated copper objects from a looted cemetery of Loma Negra, near the modern Peruvian city of Piura. They demonstrate that the extremely thin film of gold was plated on to the copper by electrochemical replacement, an electroplating technique requiring no external current.

The Loma Negra metal objects, including human figures, masks and ear ornaments, are thought to date to about AD 100 to 300, the beginning of the Moche period in Peruvian prehistory. The quality of workmanship confirms the status of Moche metalwork as the finest in the Central Andean region. Gold, silver and copper are all used, and some objects are thought to utilize a natural alloy of the three metals.

The appearance of some Loma Negra objects led Dr Lechtman to believe that a process known as depletion gilding might have been used; in that process, plant acids are used to dissolve copper from the surface of a gold-copper alloy (*Tumbaga*), leaving a thin film of gold which can be burnished to give the entire object the appearance of solid gold. Some other pieces, however, had very thin gold surfaces which had not been formed by depletion or by mechanical attachment of gold foil to the copper surface.

The surface gold on those objects was only 0.5 to 2 microns thick, so thin that it could not be seen in microscopic cross-section at 500x magnification; it was, however, even in thickness and covered even the edges of the metal sheets. A zone of gold-copper fusion showed that at some stage heat had been applied to seal the two metals firmly together.

The evenness and ubiquity of the gold film reminded Dr Lechtman of modern electroplating techniques, and once the alternative possibilities of dipping in molten gold and sweating on gold foil had been disproved by experimental replication, she investigated the possibility of electroplating by chemical replacement. All of her experi-

ments used only chemicals available in ancient Peru, and processes that did not require external electric current.

The use of aqueous solutions of corrosive salts to dissolve and then deposit the gold was similar in many ways to the technique described in the eighteenth century by Godfrey Smith in *The Laboratory or School of Arts* for the gilding of iron and steel armour: Dr Lechtman used a solution of common salt, salt-petre and potash alum, in which the gold was gently heated for two to five days. The resulting chloroauric acid is highly corrosive and would have attacked the copper sheet, so Dr Lechtman neutralized it with bicarbonate of soda. With an acid-alkali balance (pH) of 9, gold will plate out immediately on to clean copper sheeting dipped into the solution, if this is boiled gently for five minutes during immersion.

The join produced was not stable, however, and the plated sheet needed to be heated for a short time to bond the copper and gold together. A silver plate can be produced by the same method, with chalk being used as a neutralizer which will at the same time make up a thick paste which can be rubbed on to the copper base; silver plates out immediately. The plate on the Loma Negra objects proved to contain gold and silver, with the proportions of the metals in two samples being approximately even at five to one.

The chemical mechanism used by the Peruvian platers was, Dr Lechtman points out, identical with that used by the first European electroplaters. Both anodes and cathodes exist on the surface of the copper object, the anodes being small irregularities which remain visible as pits in the gold plate on completion of the plating process. The use of a scanning electron microscope to produce a photo-micrograph detected such anodic pits on the Loma Negra artifacts.

Moche metalworking seems to have been not only productive in scale, but high in technical expertise; the looted nature of all of the finds prevents further information on their social context being obtained, Dr Lechtman points out, but technical aspects of ore acquisition, organization of production and craft specialization may be illuminated by proper archaeological work in the Vicús region, of which Loma Negra forms a part. Source: *American Antiquity* (Vol 47, 1982; pp3-30)

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